



Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at <http://about.jstor.org/participate-jstor/individuals/early-journal-content>.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.

- ART. III. — 1. *Gum-Elastic and its Varieties, with a Detailed Account of its Applications and Uses, and of the Discovery of Vulcanization.* By CHARLES GOODYEAR. New Haven: Published for the Author. 1853. 8vo. 2 vols. in one.
2. *Testimony in the Case of Charles Goodyear.* By HORACE H. DAY. Trenton, N. J. 1852. 2 vols. 8vo.
3. *Speech of the HON. DANIEL WEBSTER in the great India-Rubber Suit, heard at Trenton in March, 1852.* Reported by ARTHUR CANNON. New York: Arthur and Burnett. 1852.
4. *Decision of the HON. JOSEPH HOLT, Commissioner of Patents, in the Matter of the Application of Charles Goodyear for the Extension of Letters Patent.* Washington. 1858.
5. *The Application of Charles Goodyear, Jun., Executor, etc., for the Extension of Goodyear's Vulcanizing Patent. Arguments in behalf of Applicant, by A. POLLOK, C. A. SEWARD, and J. T. BRADY.* Washington. 1864.
6. *The Petition of Charles Goodyear, Jr., Executor, for the Extension of Letters Patent granted to Charles Goodyear, deceased, for the Invention of Vulcanized India-Rubber.* New York. 1864.
7. *Discourse commemorative of the Life of Charles Goodyear, the Inventor, preached in the North Church, New Haven, July 8th, 1860.* By REV. S. W. S. DUTTON, D. D. New Haven. 1860.

THE work first named at the head of this article presents at least something unique in the art of book-making. It is self-illustrating; inasmuch as, treating of India-rubber, it is made of India-rubber. An unobservant reader, however, would scarcely suspect the fact before reading the Preface, for the India-rubber covers resemble highly polished ebony, and the leaves have the appearance of ancient paper worn soft, thin, and dingy by numberless perusals. The volume contains six hundred and twenty pages; but it is not as thick as copies of the same work printed on paper, though it is a little heavier. It is evident that the substance of which this book is composed

cannot be India-rubber in its natural state. Those leaves, thinner than paper, can be stretched only by a strong pull, and resume their shape perfectly when they are let go. There is no smell of India-rubber about them. We first saw this book in a cold room last January, but the leaves were then as flexible as old paper; and when, since, we have handled it in warm weather, they had grown no softer.

Some of our readers may have heard Daniel Webster relate the story of the India-rubber cloak and hat which one of his New York friends sent him at Marshfield in the infancy of the manufacture. He took the cloak to the piazza one cold morning, when it instantly became as rigid as sheet-iron. Finding that it stood alone, he placed the hat upon it, and left the articles standing near the front door. Several of his neighbors who passed, seeing a dark and portly figure there, took it for the lord of the mansion, and gave it respectful salutation. The same articles were liable to an objection still more serious. In the sun, even in cool weather, they became sticky, while on a hot day they would melt entirely away to the consistency of molasses. Every one remembers the thick and ill-shaped India-rubber shoes of twenty years ago, which had to be thawed out under the stove before they could be put on, and which, if left under the stove too long, would dissolve into gum that no household art could ever harden again. Some decorous gentlemen among us can also remember that, in the nocturnal combats of their college days, a flinty India-rubber shoe, in cold weather, was a missive weapon of a highly effective character.

This curious volume, therefore, cannot be made of the unmanageable stuff which Daniel Webster set up at his front door. So much is evident at a glance. But the book itself tells us that it can be subjected, without injury, to tests more severe than summer's sun and winter's cold. It can be soaked six months in a pail of water, and still be as good a book as ever. It can be boiled; it can be baked in an oven hot enough to cook a turkey; it can be soaked in brine, lye, camphene, turpentine, or oil; it can be dipped into oil of vitriol, and still no harm done. To crown its merits, no rat, mouse, worm, or moth has ever shown the slightest inclination to

make acquaintance with it. The office of a Review is not usually provided with the means of subjecting literature to such critical tests as lye, vitriol, boilers, and hot ovens. But we have seen enough elsewhere of the ordeals to which India-rubber is now subjected to believe Mr. Goodyear's statements. Remote posterity will enjoy the fruit of his labors, unless some one takes particular pains to destroy this book; for it seems that time itself produces no effect upon the India-rubber which bears the familiar stamp, "GOODYEAR'S PATENT." In the dampest corner of the dampest cellar, no mould gathers upon it, no decay penetrates it. In the hottest garret, it never warps or cracks.

The principal object of the work is to relate how this remarkable change was effected in the nature of the substance of which it treats. It cost more than two millions of dollars to do it. It cost Charles Goodyear eleven most laborious and painful years. His book is written without art or skill, but also without guile. He was evidently a laborious, conscientious, modest man, neither learned nor highly gifted, but making no pretence to learning or gifts, doing the work which fell to him with all his might, and with a perseverance never surpassed in all the history of invention and discovery. Who would have thought to find a romance in the history of India-rubber? We are familiar with the stories of poor and friendless men, possessed with an idea and pursuing their object, amid obloquy, neglect, and suffering, to the final triumph; of which final triumph other men reaped the substantial reward, leaving to the discoverer the barren glory of his achievement,—and that glory obscured by detraction. Columbus is the representative man of that illustrious order. We trust to be able to show that Charles Goodyear is entitled to a place in it. Whether we consider the prodigious and unforeseen importance of his discovery, or his scarcely paralleled devotion to his object, in the face of the most disheartening obstacles, we feel it to be due to his memory, to his descendants, and to the public, that his story should be told. Few persons will ever see his book, of which only a small number of copies were printed for private circulation. Still fewer will be at the pains to pick out the material facts from the confused mass of matter in which they

are hidden. Happily for our purpose, no one now has an interest to call his merits in question. He rests from his labors, and the patent, which was the glory and misery of his life, has expired.

Our great-grandfathers knew India-rubber only as a curiosity, and our grandfathers only as a means of erasing pencil-marks. The first specimens were brought to Europe in 1730; and as late as 1770 it was still so scarce an article, that in London it was only to be found in one shop, where a piece containing half a cubic inch was sold for three shillings. Dr. Priestley, in his work on perspective, published in 1770, speaks of it as a new article, and recommends its use to draughtsmen. This substance, however, being one of those of which nature has provided an inexhaustible supply, greater quantities found their way into the commerce of the world; until, in 1820, it was a drug in all markets, and was frequently brought as ballast merely. About this time it began to be subjected to experiments with a view to rendering it available in the arts. It was found useful as an ingredient of blacking and varnish. Its elasticity was turned to account in France in the manufacture of suspenders and garters, — threads of India-rubber being inserted in the web. In England, Mackintosh invented his still celebrated water-proof coats, which are made of two thin cloths with a paste of India-rubber between them. In chemistry, the substance was used to some extent, and its singular properties were much considered. In England and France, the India-rubber manufacture had attained considerable importance before the material had attracted the attention of American experimenters. The Europeans succeeded in rendering it useful because they did not attempt too much. The French cut the imported sheets of gum into shreds, without ever attempting to produce the sheets themselves. Mackintosh exposed no surface of India-rubber to the air, and brought no surfaces of India-rubber into contact. No one had discovered any process by which India-rubber once dissolved could be restored to its original consistency. Some of our readers may have attempted, twenty years ago, to fill up the holes in the sole of an India-rubber shoe. Nothing was easier than to melt a piece of India-rubber for the purpose; but, when

applied to the shoe, it would not harden. There was the grand difficulty, the complete removal of which cost so much money and so many years.

The ruinous failure of the first American manufacturers arose from the fact that they began their costly operations in ignorance of the existence of this difficulty. They were too fast. They proceeded in the manner of the inventor of the caloric engine, who began by placing one in a ship of great magnitude, involving an expenditure which ruined the owners.

It was in the year 1820 that a pair of India-rubber shoes was seen for the first time in the United States. They were covered with gilding, and resembled in shape the shoes of a Chinaman. They were handed about in Boston only as a curiosity. Two or three years after, a ship from South America brought to Boston five hundred pairs of shoes, thick, heavy, and ill-shaped, which sold so readily as to invite further importations. The business increased until the annual importation reached half a million pairs, and India-rubber shoes had become an article of general use. The manner in which these shoes were made by the natives of South America was frequently described in the newspapers, and seemed to present no difficulty. They were made much as farmers' wives made candles. The sap being collected from the trees, clay lasts were dipped into the liquid twenty or thirty times, each layer being smoked a little. The shoes were then hung up to harden for a few days; after which the clay was removed, and the shoes were stored for some months to harden them still more. Nothing was more natural than to suppose that Yankees could do this as well as Indians, if not far better. The raw India-rubber could then be bought in Boston for five cents a pound, and a pair of shoes made of it brought from three to five dollars. Surely here was a promising basis for a new branch of manufacture in New England. It happened too, in 1830, that vast quantities of the raw gum reached the United States. It came covered with hides, in masses, of which no use could be made in America; and it remained unsold, or was sent to Europe.

Patent-leather suggested the first American attempt to turn India-rubber to account. Mr. E. M. Chaffee, foreman of a

Boston patent-leather factory, conceived the idea, in 1830, of spreading India-rubber upon cloth, hoping to produce an article which should possess the good qualities of patent-leather, with the additional one of being water-proof. In the deepest secrecy he experimented for several months. By dissolving a pound of India-rubber in three quarts of spirits of turpentine, and adding lampblack enough to give it the desired color, he produced a composition which he supposed would perfectly answer the purpose. He invented a machine for spreading it, and made some specimens of cloth, which had every appearance of being a very useful article. The surface, after being dried in the sun, was firm and smooth; and Mr. Chaffee supposed, and his friends agreed with him, that he had made an invention of the utmost value. At this point he invited a few of the solid men of Roxbury to look at his specimens and listen to his statements. He convinced them. The result of the conference was the Roxbury India-rubber Company, incorporated in February, 1833, with a capital of thirty thousand dollars.

The progress of this Company was amazing. Within a year its capital was increased to two hundred and forty thousand dollars. Before another year had expired, this was increased to three hundred thousand; and in the year following, to four hundred thousand. The Company manufactured the cloth invented by Mr. Chaffee, and many articles made of that cloth, such as coats, caps, wagon curtains and coverings. Shoes, made without fibre, were soon introduced. Nothing could be better than the appearance of these articles when they were new. They were in the highest favor, and were sold more rapidly than the company could manufacture them. The astonishing prosperity of the Roxbury Company had its natural effect in calling into existence similar establishments in other towns. Manufacturing was started at Boston, Framingham, Salem, Lynn, Chelsea, Troy, and Staten Island, with capitals ranging from one hundred thousand dollars to half a million; and all of them appeared to prosper. There was an India-rubber mania in those years similar to that of petroleum in 1864. Not to invest in India-rubber stock was regarded by some shrewd men as indicative of inferior business talents and general dulness of comprehension. The exterior facts were certainly well calcu-

lated to lure even the most wary. Here was a material worth only a few cents a pound, out of which shoes were quickly made, which brought two dollars a pair! It was a plain case. Besides, there were the India-rubber Companies, all working to their extreme capacity, and selling all they could make.

It was when the business had reached this flourishing stage that Charles Goodyear, a bankrupt hardware merchant of Philadelphia, first had his attention directed to the material upon which it was founded. In 1834, being in New York on business, he chanced to observe the sign of the Roxbury Company, which then had a depot in that city. He had been reading in the newspapers, not long before, descriptions of the new life-preservers made of India-rubber, an application of the gum that was much extolled. Curiosity induced him to enter the store to examine the life-preservers. He bought one and took it home with him. A native of Connecticut, he possessed in full measure the Yankee propensity to look at a new contrivance, first with a view to understand its principle, and next to see if it cannot be improved. Already he had had some experience both of the difficulty of introducing an improved implement, and of the profit to be derived from its introduction. His father, the head of the firm of A. Goodyear and Sons, of which he was a member, was the first to manufacture hay-forks of spring steel, instead of the heavy, wrought-iron forks made by the village blacksmith; and Charles Goodyear could remember the time when his father reckoned it a happy day on which he had persuaded a farmer to accept a few of the new forks as a gift, on the condition of giving them a trial. But it was also very fresh in his recollection that those same forks had made their way to almost universal use, had yielded large profits to his firm, and were still a leading article of its trade, when, in 1830, the failure of Southern houses had compelled it to suspend. He was aware, too, that, if anything could extricate the house of A. Goodyear and Sons from embarrassment, it was their possession of superior methods of manufacturing and their sale of articles improved by their own ingenuity.

Upon examining his life-preserver, an improvement in the inflating apparatus occurred to him. When he was next in

New York he explained his improvement to the agent of the Roxbury Company, and offered to sell it. The agent, struck with the ingenuity displayed in the new contrivance, took the inventor into his confidence, partly by way of explaining why the Company could not then buy the improved tube, but principally with a view to enlist the aid of an ingenious mind in overcoming a difficulty that threatened the company with ruin. He told him that the prosperity of the India-rubber Companies in the United States was wholly fallacious. The Roxbury Company had manufactured vast quantities of shoes and fabrics in the cool months of 1833 and 1834, which had been readily sold at high prices; but during the following summer, the greater part of them had melted. Twenty thousand dollars' worth had been returned, reduced to the consistency of common gum, and emitting an odor so offensive that they had been obliged to bury it. New ingredients had been employed, new machinery applied, but still the articles would dissolve. In some cases, shoes had borne the heat of one summer, and melted the next. The wagon-covers became sticky in the sun, and rigid in the cold. The directors were at their wit's end;—since it required two years to test a new process, and meanwhile they knew not whether the articles made by it were valuable or worthless. If they stopped manufacturing, that was certain ruin. If they went on, they might find the product of a whole winter dissolving on their hands. The capital of the Company was already so far exhausted, that, unless the true method were speedily discovered, it would be compelled to wind up its affairs. The agent urged Mr. Goodyear not to waste time upon minor improvements, but to direct all his efforts to finding out the secret of successfully working the material itself. The Company could not buy his improved inflator; but let him learn how to make an India-rubber that would stand the summer's heat, and there was scarcely any price which it would not gladly give for the secret.

The worst apprehensions of the directors of this Company were realized. The public soon became tired of buying India-rubber shoes that could only be saved during the summer by putting them into a refrigerator. In the third year of the mania, India-rubber stock began to decline, and Roxbury

itself finally fell to two dollars and a half. Before the close of 1836, all the Companies had ceased to exist, their fall involving many hundreds of families in heavy loss. The clumsy, shapeless shoes from South America were the only ones which the people would buy. It was generally supposed that the secret of their resisting heat was that they were smoked with the leaves of a certain tree, peculiar to South America, and that nothing else in nature would answer the purpose.

The two millions of dollars lost by these Companies had one result which has proved to be worth many times that sum; it led Charles Goodyear to undertake the investigation of India-rubber. That chance conversation with the agent of the Roxbury Company fixed his destiny. If he were alive to read these lines, he would, however, protest against the use of such a word as *chance* in this connection. He really appears to have felt himself "called" to study India-rubber. He says himself:—

"From the time that his attention was first given to the subject, a strong and abiding impression was made upon his mind, that an object so desirable and important, and so necessary to man's comfort, as the making of gum-elastic available to his use, was most certainly placed within his reach. Having this presentiment, of which he could not divest himself under the most trying adversity, he was stimulated with the hope of ultimately attaining this object.

"Beyond this he would refer the whole to the great Creator, who directs the operations of mind to the development of the properties of matter, in his own way, at the time when they are specially needed, influencing some mind for every work or calling. . . . Were he to refrain from expressing his views thus briefly, he would ever feel that he had done violence to his sentiments."

This is modestly said, but his friends assure us that he felt it earnestly and habitually. It was, indeed, this steadfast conviction of the possibility of attaining his object, and his religious devotion to it, that constituted his capital in his new business. He had little knowledge of chemistry, and an aversion to complicated calculations. He was a ruined man; for after a long struggle with misfortune the firm of A. Goodyear and Sons had surrendered their all to their creditors, and still owed thirty thousand dollars. He had a family, and his health was

not robust. Upon returning home after conversing with the agent of the Roxbury Company, he was arrested for debt, and compelled to reside within the prison limits. He melted his first pound of India-rubber while he was living within those limits, and struggling to keep out of the jail itself. Thus he began his experiments in circumstances as little favorable as can be imagined. There were only two things in his favor. One was his conviction that India-rubber *could* be subjugated, and that he was the man destined to subjugate it. The other was, that, India-rubber having fallen to its old price, he could continue his labors as long as he could raise five cents and procure access to a fire. The very odium in which businessmen held India-rubber, though it long retarded his final triumph, placed an abundance of the native gum within the means even of an inmate of the debtor's prison, in which he often was during the whole period of his experimenting. He was seldom out of jail a whole year from 1835 to 1841, and never out of danger of arrest.

In a small house in Philadelphia, in the winter of 1834-35, he began his investigations. He melted his gum by the domestic fire, kneaded it with his own hands, spread it upon a marble slab, and rolled it with a rolling-pin. A prospect of success flattered him from the first and lured him on. He was soon able to produce sheets of India-rubber which appeared as firm as those imported, and which tempted a friend to advance him a sum of money sufficient to enable him to manufacture several hundred pairs of shoes. He succeeded in embossing his shoes in various patterns, which gave them a novel and elegant appearance. Mindful, however, of the disasters of the Roxbury Company, he had the prudence to store his shoes until the summer. The hot days of June reduced them all to soft and stinking paste. His friend was discouraged, and refused him further aid. For his own part, such experiences as this, though they dashed his spirits for a while, stimulated him to new efforts.

It now occurred to him, that perhaps it was the turpentine used in dissolving the gum, or the lampblack employed to color it, that spoiled his product. He esteemed it a rare piece of luck to procure some barrels of the sap, not smoked, and

still liquid. On going to the shed where the precious sap was deposited, he was accosted by an Irishman in his employ, who, in high glee, informed him that he had discovered the secret, pointing to his overalls, which he had dipped into the sap, and which were nicely coated with firm India-rubber. For a moment he thought that Jerry might have blundered into the secret. The man, however, sat down on a barrel near the fire, and, on attempting to rise, found himself glued to his seat and his legs stuck together. He had to be cut out of his overalls. The master proceeded to experiment with the sap, but soon discovered that the handsome white cloth made of it bore the heat no better than that which was produced in the usual manner.

It is remarkable, that inventors seldom derive direct aid from the science of their day. James Watt modestly ascribes to Professor Black part of the glory of his improvements in the steam-engine; but it seems plain from his own narrative, that he made his great invention of the condenser without any assistance. Professor Black assisted to instruct and form him; but the flash of genius, which made the steam-engine what we now see it, was wholly his own. The science of Glasgow was diligently questioned by him upon the defects of the old engine, but it gave him no hint of the remedy. It was James Watt, mathematical-instrument maker, earning fourteen shillings a week, who brooded over his little model until the conception of the condenser burst upon him, as he was taking his Sunday afternoon stroll on Glasgow Green. Goodyear had a similar experience. Philadelphia has always been noted for its chemists and its chemical works, and that city still supplies the greater part of the country with manufactured drugs and chemists' materials. Nevertheless, though Goodyear explained his difficulties to professors, physicians, and chemists, none of them could give him valuable information; none suggested an experiment that produced a useful result. We know not, indeed, whether science has ever explained his final success.

Satisfied that nothing could be done with India-rubber pure and simple, he concluded that a compound of some substance with India-rubber could alone render the gum available. He was correct in this conjecture, but it remained to be discovered

whether there was such a substance in nature. He tried everything he could think of. For a short time he was elated with the result of his experiments with magnesia, mixing half a pound of magnesia with a pound of gum. This compound had the advantage of being whiter than the pure sap. It was so firm that he used it as leather in the binding of a book. In a few weeks, however, he had the mortification of seeing his elegant white book-covers fermenting and softening. Afterwards, they grew as hard and brittle as shell, and so they remain to this day.

By this time, the patience of his friends and his own little fund of money were both exhausted; and, one by one, the relics of his former prosperity, even to his wife's trinkets, found their way to the pawnbroker. He was a sanguine man, as inventors need to be, always feeling that he was on the point of succeeding. The very confidence with which he announced a new conception served at length to close all ears to his solicitations. In the second year of his investigation he removed his family to the country, and went to New York, in quest of some one who had still a little faith in India-rubber. His credit was then at so low an ebb that he was obliged to deposit with the landlord a quantity of linen, spun by his excellent wife. It was never redeemed. It was sold at auction to pay the first quarter's rent; and his furniture also would have been seized, but that he had taken the precaution to sell it himself in Philadelphia, and had placed in his cottage articles of too little value to tempt the hardest creditor.

In New York,—the first resort of the enterprising and the last refuge of the unfortunate,—he found two old friends; one of whom lent him a room in Gold Street for a laboratory, and the other, a druggist, supplied him with materials on credit. Again his hopes were flattered by an apparent success. By boiling his compound of gum and magnesia in quicklime and water, an article was produced which seemed to be all that he could desire. Some sheets of India-rubber made by this process drew a medal at the fair of the American Institute in 1835, and were much commended in the newspapers. Nothing could exceed the smoothness and firmness of the surface of these sheets; nor have they to this day been surpassed in

these particulars. He obtained a patent for the process, manufactured a considerable quantity, sold his product readily, and thought his difficulties were at an end. In a few weeks his hopes were dashed to the ground. He found that a drop of weak acid, such as apple juice or vinegar and water, instantly annihilated the effect of the lime, and made the beautiful surface of his cloth sticky.

Undaunted, he next tried the experiment of mixing quicklime with pure gum. He tells us that, at this time, he used to prepare a gallon jug of quicklime at his room in Gold Street, and carry it on his shoulder to Greenwich Village, distant three miles, where he had access to horse-power for working his compound. This experiment, too, was a failure. The lime in a short time appeared to consume the gum with which it was mixed, leaving a substance that crumbled to pieces.

Accident suggested his next process, which, though he knew it not, was a step toward his final success. Except his almost unparalleled perseverance, the most marked trait in the character of this singular man was his love for beautiful forms and colors. An incongruous garment or decoration upon a member of his family, or anything tawdry or ill-arranged in a room, gave him positive distress. Accordingly, we always find him endeavoring to decorate his India-rubber fabrics. It was in bronzing the surface of some India-rubber drapery that the accident happened to which we have referred. Desiring to remove the bronze from a piece of the drapery, he applied aquafortis for the purpose, which did indeed have the effect desired, but it also discolored the fabric and appeared to spoil it. He threw away the piece as useless. Several days after, it occurred to him that he had not sufficiently examined the effect of the aquafortis, and, hurrying to his room, he was fortunate enough to find it again. A remarkable change appeared to have been made in the India-rubber. He does not seem to have been aware that aquafortis is two fifths sulphuric acid. Still less did he ever suspect that the surface of his drapery had really been "vulcanized." All he knew was, that India-rubber cloth "cured," as he termed it, by aquafortis, was incomparably superior to any previously made, and bore a degree of heat that rendered it available for many valuable purposes.

He was again a happy man. A partner, with ample capital, joined him. He went to Washington and patented his process. He showed his specimens to President Jackson, who expressed in writing his approval of them. Returning to New York, he prepared to manufacture on a great scale, hired the abandoned India-rubber works on Staten Island, and engaged a store in Broadway for the sale of his fabrics. In the midst of these grand preparations, his zeal in experimenting almost cost him his life. Having generated a large quantity of poisonous gas in his close room, he was so nearly suffocated that it was six weeks before he recovered his health. Before he had begun to produce his fabrics in any considerable quantity, the commercial storm of 1836 swept away the entire property of his partner, which put a complete stop to the operations in India-rubber, and reduced poor Goodyear to his normal condition of beggary. Beggary it literally was; for he was absolutely dependent upon others for the means of sustaining life. He mentions that, soon after this crushing blow, his family having previously joined him in New York, he awoke one morning to discover that he had neither an atom of food for them, nor a cent to buy it with. Putting in his pocket an article that he supposed a pawnbroker would value, he set out in the hope of procuring enough money to sustain them for one day. Before reaching the sign, so familiar to him, of the three golden balls, he met a terrible being to a man in his situation,—a creditor! Hungry and dejected, he prepared his mind for a torrent of bitter reproaches; for this gentleman was one whose patience he felt he had abused. What was his relief when his creditor accosted him gayly with, “Well, Mr. Goodyear, what can I do for you to-day?” His first thought was, that an insult was intended, so preposterous did it seem that this man could really desire to aid him further. Satisfied that the offer was well meant, he told his friend that he had come out that morning in search of food for his family, and that a loan of fifteen dollars would greatly oblige him. The money was instantly produced, which enabled him to postpone his visit to the pawnbroker for several days. The pawnbroker was still, however, his frequent resource all that year, until the few remains of his late brief prosperity had all disappeared.

But he never for a moment let go his hold upon India-rubber. A timely loan of a hundred dollars from an old friend enabled him to remove his family to Staten Island, near the abandoned India-rubber factory. Having free access to the works, he and his wife contrived to manufacture a few articles of his improved cloth, and to sell enough to provide daily bread. His great object there was to induce the directors of the suspended Company to recommence operations upon his new process. But so completely sickened were they of the very name of a material which had involved them in so much loss and discredit, that during the six months of his residence on the island he never succeeded in persuading one man to do so much as come to the factory and look at his specimens. There were thousands of dollars' worth of machinery there, but not a single shareholder cared even to know the condition of the property. This was the more remarkable, since he was unusually endowed by nature with the power to inspire other men with his own confidence. The magnates of Staten Island, however, involved as they were in the general shipwreck of property and credit, were inexorably deaf to his eloquence.

As he had formerly exhausted Philadelphia, so now New York seemed exhausted. He became even an object of ridicule. He was regarded as an India-rubber monomaniac. One of his New York friends having been asked how Mr. Goodyear could be recognized in the street, replied: "If you see a man with an India-rubber coat on, India-rubber-shoes, an India-rubber cap, and in his pocket an India-rubber purse with not a cent in it, that is he." He was in the habit then of wearing his material in every form, with the twofold view of testing and advertising it.

In September, 1836, aided again by a small loan, he packed a few of his best specimens in his carpet-bag, and set out alone for the cradle of the India-rubber manufacture,—Roxbury. The ruin of the great Company there was then complete, and the factory was abandoned. All that part of Massachusetts was suffering from the total depreciation of the India-rubber stocks. There were still, however, two or three persons who could not quite give up India-rubber. Mr. Chaffee, the originator of the manufacture in America, welcomed warmly a

brother experimenter, admired his specimens, encouraged him to persevere, procured him friends, and, what was more important, gave him the use of the enormous machinery standing idle in the factory. A brief, delusive prosperity again relieved the monotony of misfortune. By his new process, he made shoes, piano-covers, and carriage-cloths, so superior to any previously produced in the United States as to cause a temporary revival of the business, which enabled him to sell rights to manufacture under his patents. His profits in a single year amounted to four or five thousand dollars. Again he had his family around him, and felt a boundless confidence in the future.

An event upon which he had depended for the completeness of his triumph plunged him again into ruin. He received an order from the government for a hundred and fifty India-rubber mail-bags. Having perfect confidence in his ability to execute this order, he gave the greatest possible publicity to it. All the world should now see that Goodyear's India-rubber was all that Goodyear had represented it. The bags were finished; and beautiful bags they were, — smooth, firm, highly polished, well-shaped, and indubitably water-proof. He had them hung up all round the factory, and invited every one to come and inspect them. They were universally admired, and the maker was congratulated upon his success. It was in the summer that these fatal bags were finished. Having occasion to be absent for a month, he left them hanging in the factory. Judge of his consternation when, on his return, he found them softening, fermenting, and dropping off their handles. The aquafortis did indeed "cure" the surface of his India-rubber, but only the surface. Very thin cloth made by this process was a useful and somewhat durable article; but for any other purpose, it was valueless. The public and signal failure of the mail-bags, together with the imperfection of all his products except his thinnest cloth, suddenly and totally destroyed his rising business. Everything he possessed that was salable was sold at auction to pay his debts. He was again penniless and destitute, with an increased family and an aged father dependent upon him.

His friends, his brothers, and his wife now joined in dissuading him from further experiments. Were not four years of

such vicissitude enough? Who had ever touched India-rubber without loss? Could he hope to succeed, when so many able and enterprising men had failed? Had he a right to keep his family in a condition so humiliating and painful? He had succeeded in the hardware business; why not return to it? There were those who would join him in any rational undertaking; but how could he expect that any one would be willing to throw more money into a bottomless pit that had already engulfed millions without result? These arguments he could not answer, and we cannot; the friends of all the great inventors have had occasion to use the same. It seemed highly absurd to the friends of Fitch, Watt, Fulton, Wedgewood, Whitney, Arkwright, that they should forsake the beaten track of business to pursue a path that led through the wilderness to nothing but wilderness. Not one of these men, perhaps, could have made a reasonable reply to the remonstrances of their friends. They only felt, as poor Goodyear felt, that the steep and thorny path which they were treading was the path they *must* pursue. A power of which they could give no satisfactory account urged them on. And when we look closely into the lives of such men, we observe that, in their dark days, some trifling circumstance was always occurring that set them upon new inquiries and gave them new hopes. It might be an *ignis fatuus* that led them farther astray, or it might be genuine light which brought them into the true path.

Goodyear might have yielded to his friends on this occasion, for he was an affectionate man, devoted to his family, had not one of those trifling events occurred which inflamed his curiosity anew. During his late transient prosperity, he had employed a man, Nathaniel Hayward by name, who had been foreman of one of the extinct India-rubber companies. He found him in charge of the abandoned factory, and still making a few articles on his own account by a new process. To harden his India-rubber, he put a very small quantity of sulphur into it, or sprinkled sulphur upon the surface and dried it in the sun. Mr. Goodyear was surprised to observe that this process seemed to produce the same effect as the application of aquafortis. It does not appear to have occurred to him that Hayward's process and his own were essentially the

same. A chemical dictionary would have informed him that sulphuric acid enters largely into the composition of aquafortis, from which he might have inferred that the only difference between the two methods was, that Hayward employed the sun, and Goodyear nitric acid, to give the sulphur effect. Hayward's goods, however, were liable to a serious objection: the smell of the sulphur, in warm weather, was intolerable. Hayward, it appears, was a very illiterate man; and the only account he could give of his invention was, that it was revealed to him in a dream. His process was of so little use to him, that Goodyear bought his patent for a small sum, and gave him employment at monthly wages until the mail-bag disaster deprived him of the means of doing so.

In combining sulphur with India-rubber, Goodyear had approached so near his final success that one step more brought him to it. He was certain that he was very close to the secret. He saw that sulphur had a mysterious power over India-rubber when a union could be effected between the two substances. True, there was an infinitesimal quantity of sulphur in his mail-bags, and they had melted in the shade; but the surface of his cloth, powdered with the sulphur and dried in the sun, bore the sun's heat. Here was a mystery. The problem was, how to produce in a *mass* of India-rubber the change effected on the surface by sulphur and sun? He made numberless experiments. He mixed with the gum large quantities of sulphur, and small quantities. He exposed his compound to the sun, and held it near a fire. He felt that he had the secret in his hands; but for many weary months it eluded him.

And, after all, it was an accident that revealed it; but an accident that no man in the world but Charles Goodyear could have interpreted, nor he, but for his five years' previous investigation. At Woburn one day, in the spring of 1839, he was standing with his brother and several other persons near a very hot stove. He held in his hand a mass of his compound of sulphur and gum, upon which he was expatiating in his usual vehement manner,—the company exhibiting the indifference to which he was accustomed. In the crisis of his argument he made a violent gesture, which brought the mass in

contact with the stove, which was hot enough to melt India-rubber instantly ; upon looking at it a moment after, he perceived that his compound had not melted in the least degree ! It had charred as leather chars, but no part of the surface had dissolved. There was not a sticky place upon it. To say that he was astonished at this would but faintly express his ecstasy of amazement. The result was absolutely new to all experience, — India-rubber not melting in contact with red-hot iron ! A man must have been five years absorbed in the pursuit of an object to comprehend his emotions. He felt as Columbus felt when he saw the land-bird alighting upon his ship, and the drift-wood floating by. But, like Columbus, he was surrounded with an unbelieving crew. Eagerly he showed his charred India-rubber to his brother, and to the other by-standers, and dwelt upon the novelty and marvellousness of his fact. They regarded it with complete indifference. The good man had worn them all out. Fifty times before, he had run to them, exulting in some new discovery, and they supposed, of course, that this was another of his chimeras.

He followed the new clew with an enthusiasm which his friends would have been justified in calling frenzy, if success had not finally vindicated him. He soon discovered that his compound would not melt at any degree of heat. It next occurred to him to ascertain at how low a temperature it would char, and whether it was not possible to *arrest* the combustion at a point that would leave the India-rubber elastic, but deprived of its adhesiveness. A single experiment proved that this was possible. After toasting a piece of his compound before an open fire, he found that, while part of it was charred, a rim of India-rubber round the charred portion was elastic still, and even more elastic than pure gum. In a few days he had established three facts ; — first, that this rim of India-rubber would bear a temperature of two hundred and seventy-eight degrees without charring ; second, that it would not melt or soften at any heat ; third, that, placed between blocks of ice and left out of doors all night, it would not stiffen in the least degree. He had triumphed, and he knew it. He tells us that he now “ felt himself amply repaid for the past, and quite indifferent as to the trials of the future.” It was well he was

so, for his darkest days were before him, and he was still six years from a practicable success. He had, indeed, proved that a compound of sulphur and India-rubber, in proper proportions and in certain conditions, being subjected for a certain time to a certain degree of heat, undergoes a change which renders it perfectly available for all the uses to which he had before attempted in vain to apply it. But it remained to be ascertained what were those proper proportions, what were those conditions, what was that degree of heat, what was that certain time, and by what means the heat could be best applied.

The difficulty of all this may be inferred when we state that at the present time it takes an intelligent man a year to learn how to conduct the process with certainty, though he is provided, from the start, with the best implements and appliances which twenty years' experience has suggested. And poor Goodyear had now reduced himself, not merely to poverty, but to isolation. No friend of his could conceal his impatience when he heard him pronounce the word India-rubber. Business-men recoiled from the name of it. He tells us that two entire years passed, after he had made his discovery, before he had convinced one human being of its value. Now, too, his experiments could no longer be carried on with a few pounds of India-rubber, a quart of turpentine, a phial of aquafortis, and a little lampblack. He wanted the means of producing a high, uniform, and controllable degree of heat,—a matter of much greater difficulty than he anticipated. We catch brief glimpses of him at this time in the volumes of testimony. We see him waiting for his wife to draw the loaves from her oven, that he might put into it a batch of India-rubber to bake, and watching it all the evening, far into the night, to see what effect was produced by one hour's, two hours', three hours', six hours' baking. We see him boiling it in his wife's saucepans, suspending it before the nose of her teakettle, and hanging it from the handle of that vessel to within an inch of the boiling water. We see him roasting it in the ashes and in hot sand, toasting it before a slow fire and before a quick fire, cooking it for one hour and for twenty-four hours, changing the proportions of his compound and mixing them in different

ways. No success rewarded him while he employed only domestic utensils. Occasionally, it is true, he produced a small piece of perfectly vulcanized India-rubber; but upon subjecting other pieces to precisely the same process, they would blister or char.

Then we see him resorting to the shops and factories in the neighborhood of Woburn, asking the privilege of using an oven after working hours, or of hanging a piece of India-rubber in the "man-hole" of the boiler. The foremen testify that he was a great plague to them, and smeared their works with his sticky compound; but, though they regarded him as little better than a troublesome lunatic, they all appear to have helped him very willingly. He frankly confesses that he lived at this time on charity; for, although *he* felt confident of being able to repay the small sums which pity for his family enabled him to borrow, his neighbors who lent him the money were as far as possible from expecting payment. Pretending to lend, they meant to give. One would pay his butcher's bill or his milk bill; another would send in a barrel of flour; another would take in payment some articles of the old stock of India-rubber; and some of the farmers allowed his children to gather sticks in their fields to heat his hillocks of sand containing masses of sulphurized India-rubber. If the people of New England were not the most "neighborly" people in the world, his family must have starved, or he must have given up his experiments. But, with all the generosity of his neighbors, his children were often sick, hungry, and cold, without medicine, food, or fuel. One witness testifies: "I found (in 1839) that they had not fuel to burn nor food to eat, and did not know where to get a morsel of food from one day to another, unless it was sent in to them." We can neither justify nor condemn their father. Imagine Columbus within sight of the new world, and his obstinate crew declaring it was only a mirage, and refusing to row him ashore! Never was mortal man surer that he had a fortune in his hand, than Charles Goodyear was when he would take a piece of scorched and dingy India-rubber from his pocket and expound its marvellous properties to a group of incredulous villagers. Sure also was he that he was just upon the point of a practicable success. Give him but an oven, and

would he not turn you out fire-proof and cold-proof India-rubber, as fast as a baker can produce loaves of bread? Nor was it merely the hope of deliverance from his pecuniary straits that urged him on. In all the records of his career, we perceive traces of something nobler than this. His health being always infirm, he was haunted with the dread of dying before he had reached a point in his discoveries where other men, influenced by ordinary motives, could render them available.

By the time that he had exhausted the patience of the foremen of the works near Woburn, he had come to the conclusion that an oven was the proper means of applying heat to his compound. An oven he forthwith determined to build. Having obtained the use of a corner of a factory yard, his aged father, two of his brothers, his little son, and himself sallied forth, with pickaxe and shovels, to begin the work; and when they had done all that unskilled labor could effect towards it, he induced a mason to complete it, and paid him in bricklayers' aprons made of aquafortized India-rubber. This first oven was a tantalizing failure. The heat was neither uniform nor controllable. Some of the pieces of India-rubber would come out so perfectly "cured" as to demonstrate the utility of his discovery; but others, prepared in precisely the same manner, as far as he could discern, were spoiled, either by blistering or charring. He was puzzled and distressed beyond description; and no single voice consoled or encouraged him. Out of the first piece of cloth which he succeeded in vulcanizing he had a coat made for himself, which was not an ornamental garment in its best estate; but, to prove to the unbelievers that it would stand fire, he brought it so often in contact with hot stoves, that at last it presented an exceedingly dingy appearance. His coat did not impress the public favorably, and it served to confirm the opinion that he was laboring under a mania.

In the midst of his first disheartening experiments with sulphur, he had an opportunity of escaping at once from his troubles. A house in Paris made him an advantageous offer for the use of his aquafortis process. From the abyss of his misery the honest man promptly replied, that that process, valuable as it was, was about to be superseded by a new method, which he

was then perfecting, and as soon as he had developed it sufficiently he should be glad to close with their offers. Can we wonder that his neighbors thought him mad?

It was just after declining the French proposal that he endured his worst extremity of want and humiliation. It was in the winter of 1839-40. One of those long and terrible snowstorms for which New England is noted had been raging for many hours, and he awoke one morning to find his little cottage half buried in snow, the storm still continuing, and in his house not an atom of fuel nor a morsel of food. His children were very young, and he was himself sick and feeble. The charity of his neighbors was exhausted, and he had not the courage to face their reproaches. As he looked out of the window upon the dreary and tumultuous scene, "fit emblem of his condition," he remarks, he called to mind that, a few days before, an acquaintance, a mere acquaintance, who lived some miles off, had given him upon the road a more friendly greeting than he was then accustomed to receive. It had cheered his heart as he trudged sadly by, and it now returned vividly to his mind. To this gentleman he determined to apply for relief, if he could reach his house. Terrible was his struggle with the wind and the deep drifts. Often he was ready to faint with fatigue, sickness, and hunger, and he would be obliged to sit down upon a bank of snow to rest. He reached the house and told his story, not omitting the oft-told tale of his new discovery,—that mine of wealth, if only he could procure the means of working it! The eager eloquence of the inventor was seconded by the gaunt and yellow face of the man. His generous acquaintance entertained him cordially, and lent him a sum of money, which not only carried his family through the worst of the winter, but enabled him to continue his experiments on a small scale. O. B. Coolidge, of Woburn, was the name of this benefactor.

On another occasion, when he was in the most urgent need of materials, he looked about his house to see if there was left one relic of better days upon which a little money could be borrowed. There was nothing except his children's school-books,—the last things from which a New-Englander is willing to part. There was no other resource. He gathered them up and sold

them for five dollars, with which he laid in a fresh stock of gum and sulphur, and kept on experimenting.

Seeing no prospect of success in Massachusetts, he now resolved to make a desperate effort to get to New York, feeling confident that the specimens he could take with him would convince some one of the superiority of his new method. He was beginning to understand the causes of his many failures, but he saw clearly that his compound could not be worked with certainty without expensive apparatus. It was a very delicate operation, requiring exactness and promptitude. The conditions upon which success depended were numerous, and the failure of one spoiled all. To vulcanize India-rubber is about as difficult as to make perfect bread; but the art of bread-making was the growth of ages, and Charles Goodyear was only ten years and a half in perfecting his process. Thousands of ingenious men and women, aided by many happy accidents, must have contributed to the successive invention of bread; but he was only one man, poor and sick. It cost him thousands of failures to learn that a little acid in his sulphur caused the blistering; that his compound must be heated almost immediately after being mixed, or it would never vulcanize; that a portion of white lead in the compound greatly facilitated the operation and improved the result; and when he had learned these facts, it still required costly and laborious experiments to devise the best methods of compounding his ingredients, the best proportions, the best mode of heating, the proper duration of the heating, and the various useful effects that could be produced by varying the proportions and the degree of heat. He tells us that many times, when, by exhausting every resource, he had prepared a quantity of his compound for heating, it was spoiled because he could not, with his inadequate apparatus, apply the heat soon enough.

To New York, then, he directed his thoughts. Merely to get there cost him a severer and a longer effort than men in general are capable of making. First he walked to Boston, ten miles distant, where he hoped to be able to borrow from an old acquaintance fifty dollars, with which to provide for his family and pay his fare to New York. He not only failed in this, but he was arrested for debt and thrown into prison.

Even in prison, while his father was negotiating to secure his release, he labored to interest men of capital in his discovery, and made proposals for founding a factory in Boston. Having obtained his liberty, he went to a hotel, and spent a week in vain efforts to effect a small loan. Saturday night came, and with it his hotel bill, which he had no means of discharging. In an agony of shame and anxiety, he went to a friend, and entreated the sum of five dollars to enable him to return home. He was met with a point-blank refusal. In the deepest dejection, he walked the streets till late in the night, and strayed at length, almost beside himself, to Cambridge, where he ventured to call upon a friend and ask shelter for the night. He was hospitably entertained, and the next morning walked wearily home, penniless and despairing. At the door of his house a member of his family met him with the news that his youngest child, two years of age, whom he had left in perfect health, was dying. In a few hours he had in his house a dead child, but not the means of burying it, and five living dependents without a morsel of food to give them. A storekeeper near by had promised to supply the family, but, discouraged by the unforeseen length of the father's absence, he had that day refused to trust them further. In these terrible circumstances, he applied to a friend upon whose generosity he knew he could rely, one who had never failed him. He received in reply a letter of severe and cutting reproach, enclosing seven dollars, which his friend explained was given only out of pity for his innocent and suffering family. A stranger, who chanced to be present when this letter arrived, sent them a barrel of flour,—a timely and blessed relief. The next day the family followed on foot the remains of the little child to the grave.

A relation in a distant part of the country, to whom Goodyear revealed his condition, sent him fifty dollars, which enabled him to get to New York. He had touched bottom. The worst of his trials were over. In New York, he had the good fortune to make the acquaintance of two brothers, William Rider and Emory Rider, men of some property and great intelligence, who examined his specimens, listened to his story, believed in him, and agreed to aid him to continue his experiments, and to supply his family until he had rendered his dis-

covery available. From that time, though he was generally embarrassed in his circumstances, his family never wanted bread, and he was never obliged to suspend his experiments. Aided by the capital, the sympathy, and the ingenuity of the brothers Rider, he spent a year in New York in the most patient endeavors to overcome the difficulties in heating his compound. Before he had succeeded, their resources failed. But he had made such progress in demonstrating the practicability of his process, that his brother-in-law, William De Forrest, a noted woollen manufacturer, took hold of the project in earnest, and aided him to bring it to perfection. Once more, however, he was imprisoned for debt. This event conquered his scruples against availing himself of the benefit of the bankrupt act, which finally delivered him from the danger of arrest. We should add, however, that, as soon as he began to derive income from his invention, he reassumed his obligations to his old creditors, and discharged them gradually.

It was not till the year 1844, more than ten years after he began to experiment, and more than five years after discovering the secret of vulcanization, that he was able to conduct his process with absolute certainty, and to produce vulcanized India-rubber with the requisite expedition and economy. We can form some conception of the difficulties overcome by the fact, that the advances of Mr. De Forrest in aid of the experiments reached the sum of forty-six thousand dollars,—an amount the inventor did not live long enough to repay.

His triumph had been long deferred, and we have seen in part how much it had cost him. But his success proved to be richly worth its cost. He had added to the arts, not a new material merely, but a new class of materials, applicable to a thousand diverse uses. His product had more than the elasticity of India-rubber, while it was divested of all those properties which had lessened its utility. It was still India-rubber, but its surfaces would not adhere, nor would it harden at any degree of cold, nor soften at any degree of heat. It was a cloth impervious to water. It was paper that would not tear. It was parchment that would not crease. It was leather which neither rain nor sun would injure. It was ebony that could be run into a mould. It was ivory that could be worked like

wax. It was wood that never cracked, shrunk, nor decayed. It was metal, "elastic metal," as Daniel Webster termed it, that could be wound round the finger or tied into a knot, and which preserved its elasticity almost like steel. Trifling variations in the ingredients, in the proportions, and in the heating, made it either as pliable as kid, tougher than ox-hide, as elastic as whale-bone, or as rigid as flint.

All this is stated in a moment, but each of these variations in the material, as well as every article made from them, cost this indefatigable man days, weeks, months, or years of experiment. It cost him, for example, several years of most expensive trial to obviate the objection to India-rubber fabrics caused by the liability of the gum to peel from the cloth. He tried every known textile fabric and every conceivable process before arriving at the simple expedient of mixing fibre with the gum, by which, at length, the perfect India-rubber cloth was produced. This invention he considered only second in value to the discovery of vulcanization. The India-rubber shoe, as we now have it, is an admirable article, — light, strong, elegant in shape, with a fibrous sole that does not readily wear, cut, or slip. As the shoe is made and joined before vulcanization, a girl can make twenty-five pairs in a day. They are cut from the soft sheets of gum and joined by a slight pressure of the hand. But almost every step of this process, now so simple and easy, was patiently elaborated by Charles Goodyear. A million and a half of pairs per annum is now the average number made in the United States by his process, though the business languishes somewhat from the high price of the raw materials. The gum, which, when Goodyear began his experiments, was a drug at five cents a pound, has recently been sold at one dollar and twenty cents a pound, with all its impurities. Even at this high price the annual import ranges at from four to five millions of pounds.

Poor Richard informs us that Necessity never makes a good bargain. Mr. Goodyear was always a prey to necessity. Nor was he ever a good man of business. He was too entirely an inventor to know how to dispose of his inventions to advantage; and he could never feel that he had accomplished his mission with regard to India-rubber. As soon as he had

brought his shoemaking process to the point where other men could make it profitable, he withdrew from manufacturing, and sold rights to manufacture for the consideration of half a cent per pair. Five cents had been reasonable enough, and would have given him ample means to continue his labors. Half a cent kept him subject to necessity, which seemed to compel him to dispose of other rights at rates equally low. Thus it happened that, when the whole India-rubber business of the country paid him tribute, or ought to have paid it, he remained an embarrassed man. He had, too, the usual fate of inventors, in having to contend with the infringers of his rights,—men who owed their all to his ingenuity and perseverance. We may judge, however, of the rapidity with which the business grew, by the fact that, six years after the completion of his vulcanizing process, the holders of rights to manufacture shoes by that process deemed it worth while to employ Daniel Webster to plead their cause, and to stimulate his mind by a fee of twenty-five thousand dollars. It is questionable if Charles Goodyear ever derived that amount from his patents, if we deduct from his receipts the money spent in further developing his discovery. His ill-health obliged him to be abstemious, and he had no expensive tastes. It was only in his laboratory that he was lavish, and there he was lavish indeed.

His friends still smiled at his zeal, or reproached him for it. It has been only since the mighty growth of the business in his products that they have acknowledged that he was right and that they were wrong. They remember him, sick, meagre, and yellow, now coming to them with a walking-stick of India-rubber, exulting in the new application of his material, and predicting its general use, while they objected that his stick had cost him fifty dollars; now running about among the comb factories, trying to get reluctant men to try their tools upon hard India-rubber, and producing at length a set of combs that cost twenty times the price of ivory ones; now shutting himself up for months, endeavoring to make a sail of India-rubber fabric, impervious to water, that should never freeze, and to which no sleet or ice should ever cling; now exhibiting a set of cutlery with India-rubber handles, or a picture set in

an India-rubber frame, or a book with India-rubber covers, or a watch with an India-rubber case; now experimenting with India-rubber tiles for floors, which he hoped to make as brilliant in color as those of mineral, as agreeable to the tread as carpet, and as durable as an ancient floor of oak. There is nothing in the history of invention more remarkable than the devotion of this man to his object. No crusader was ever so devoted to his vow, no lover to his mistress, as he was to his purpose of showing mankind what to do with India-rubber. The doorplate of his office was made of it; his portrait was painted upon and framed with it; his book, as we have seen, was wholly composed of it; and his mind, by night and day, was surcharged with it. He never went to sleep without having within reach writing materials and the means of making a light, so that, if he should have an idea in the night, he might be able to secure it. Some of his best ideas, he used to say, were saved to mankind by this precaution.

It is not well for any man to be thus absorbed in his object. To Goodyear, whose infirm constitution peculiarly needed repose and recreation, it was disastrous, and at length fatal. It is well with no man who does not play as well as work. Fortunately, we are all beginning to understand this. We are beginning to see that a devotion to the business of life which leaves no reserve of force and time for social pleasures and the pursuit of knowledge, diminishes even our power to conduct business with the sustained and intelligent energy requisite for a safe success. That is a melancholy passage in one of Theodore Parker's letters, written in the premature decline of his powers, in which he laments that he had not, like Franklin, joined a club, and taken an occasional ramble with young companions in the country, and played billiards with them in the evening. He added, that he intended to lead a better life in these particulars for the future; but who can reform at forty-seven? And the worst of it is, that ill-health, the natural ally of all evil, favors intensity, lessening both our power and our inclination to get out of the routine that is destroying us. Goodyear, always sick, had been for so many years the slave of his pursuit, he had been so spurred on by necessity, and lured by partial success, that, when at last he might have rested, he could not.

It does not become us, however, who reap the harvest, to censure him who wore himself out in sowing the seed. The harvest is great,—greater than any but he anticipated. His friends know now that he never over-estimated the value of his invention. They know now what he meant when he said that no one but himself would take the trouble to apply his material to the thousand uses of which it was capable, because each new application demanded a course of experiments that would discourage any one who entered upon it only with a view to profit. The India-rubber manufacture, since his death, has increased greatly in extent, but not much in other respects, and some of the ideas which he valued most remain undeveloped. He died, for example, in the conviction that sails of India-rubber cloth would finally supersede all others. He spent six months and five thousand dollars in producing one or two specimens, which were tried and answered their purpose well; but he was unable to bring his sail-making process to an available perfection. The sole difficulty was to make his sails as light as those of cloth. He felt certain of being able to accomplish this; but in the multiplicity of his objects and the pressure of his embarrassments, he was compelled to defer the completion of his plans to a day that never came.

The catalogue of his successful efforts is long and striking. The second volume of his book is wholly occupied with that catalogue. He lived to see his material applied to nearly five hundred uses, to give employment in England, France, Germany, and the United States to sixty thousand persons, who annually produced merchandise of the value of eight millions of dollars. A man does much who only founds a new kind of industry; and he does more when that industry gives value to a commodity that before was nearly valueless. But we should greatly undervalue the labors of Charles Goodyear, if we regarded them only as opening a new source of wealth; for there have been found many uses of India-rubber, as prepared by him, which have an importance far superior to their commercial value. Art, science, and humanity are indebted to him for a material which serves the purposes of them all, and serves them as no other known material could.

Some of our readers have been out on the picket-line during the war. They know what it is to stand motionless in a wet and miry rifle-pit, in the chilling rain of a Southern winter's night. Protected by India-rubber boots, blanket, and cap, the picket-man performs in comparative comfort a duty which, without that protection, would make him a cowering and shivering wretch, and plant in his bones a latent rheumatism to be the torment of his old age. Goodyear's India-rubber enables him to come in from his pit as dry as he was when he went into it, and he comes in to lie down with an India-rubber blanket between him and the damp earth. If he is wounded, it is an India-rubber stretcher, or an ambulance provided with India-rubber springs, that gives him least pain on his way to the hospital, where, if his wound is serious, a water-bed of India-rubber gives ease to his mangled frame, and enables him to endure the wearing tedium of an unchanged posture. Bandages and supporters of India-rubber avail him much when first he begins to hobble about his ward. A piece of India-rubber at the end of his crutch lessens the jar and the noise of his motions, and a cushion of India-rubber is comfortable to his armpit. The springs which close the hospital door, the bands which exclude the drafts from doors and windows, his pocket-comb and cup and thimble, are of the same material. From jars hermetically closed with India-rubber he receives the fresh fruit that is so exquisitely delicious to a fevered mouth. The instrument-case of his surgeon and the store-room of his matron contain many articles whose utility is increased by the use of it, and some that could be made of nothing else. His shirts and sheets pass through an India-rubber clothes-wringer, which saves the strength of the washerwoman and the fibre of the fabric. When the government presents him with an artificial leg, a thick heel and elastic sole of India-rubber give him comfort every time he puts it to the ground. An India-rubber pipe with an inserted bowl of clay, a billiard-table provided with India-rubber cushions and balls, can solace his long convalescence.

In the field, this material is not less strikingly useful. During this war, armies have marched through ten days of rain, and slept through as many rainy nights, and come out dry into

the returning sunshine, with its artillery untarnished and its ammunition uninjured, because men and munitions were all under India-rubber. When Goodyear's ideas are carried out, it will be by pontoons of inflated India-rubber that rivers will be crossed. A pontoon-train will then consist of one wagon drawn by two mules; and if the march is through a country that furnishes the wooden part of the bridge, a man may carry a pontoon on his back in addition to his knapsack and blanket.

In the naval service we meet this material in a form that attracts little attention, though it serves a purpose of perhaps unequalled utility. Mechanics are aware, that, from the time of James Watt to the year 1850, the grand desideratum of the engine-builder was a perfect joint, — a joint that would not admit the escape of steam. A steam-engine is all over joints and valves, from most of which some steam sooner or later would escape, since an engine in motion produces a continual jar that finally impaired the best joint that art could make. The old joint-making process was exceedingly expensive. The two surfaces of iron had to be most carefully ground and polished, then screwed together, and the edges closed with white lead. By the use of a thin sheet of vulcanized India-rubber, placed between the iron surfaces, not only is all this expense saved, but a joint is produced that is absolutely and permanently perfect. It is not even necessary to rub off the roughness of the casting, for the rougher the surface, the better the joint. Goodyear's invention supplies an article that Watt and Fulton sought in vain, and which would seem to put the finishing touch to the steam-engine, — if, in these days of improvement, anything whatever could be considered finished. At present, all engines are provided with these joints and valves, which save steam, diminish jar, and facilitate the separation of the parts. It is difficult to compute the value of this improvement in money. We are informed, however, by competent authority, that a steamer of two thousand tons saves ten thousand dollars a year by its use. Such is the demand for the engine-packing, as it is termed, that the owners of the factory where it is chiefly made, after constructing the largest water-wheel in the world, found it insufficient for their growing business, and

were obliged to add to it a steam-engine of two hundred horse-power. The New York agent of this company sells about a million dollars' worth of packing per annum.

Belting for engines is another article for which Goodyear's compound is superior to any other, inasmuch as the surface of the India-rubber clings to the iron wheel better than leather or fabric. Leather polishes and slips; India-rubber does not polish, and holds to the iron so firmly as to save a large percentage of power. It is no small advantage merely to save leather for other uses, since leather is an article of which the supply is strictly limited. It is not uncommon for India-rubber belts to be furnished, which, if made of leather, would require more than a hundred hides. Emery-wheels of this material have been recently introduced. They were formerly made of wood coated with emery, which soon wore off. In the new manufacture, the emery is kneaded into the entire mass of the wheel, which can be worn down till it is all consumed. On the same principle the instruments used to sharpen scythes are also made. Of late we hear excellent accounts of India-rubber as a basis for artificial teeth. It is said to be lighter, more agreeable, less expensive, than gold or platina, and not less durable. We have seen also some very pretty watch-cases of this material, elegantly inlaid with gold.

It thus appears, that the result of Mr. Goodyear's long and painful struggles was the production of a material which now ranks with the leading compounds of commerce and manufacture, such as glass, brass, steel, paper, porcelain, paint. Considering its peculiar and varied utility, it is perhaps inferior in value only to paper, steel, and glass. We see, also, that the use of the new compound lessens the consumption of several commodities, such as ivory, bone, ebony, and leather, which it is desirable to save, because the demand for them tends to increase faster than the supply. When a set of ivory billiard-balls costs fifty dollars, and civilization presses upon the domain of the elephant, it is well to make our combs and our paper-knives of something else.

That inventions so valuable should be disputed and pirated was something which the history of all the great inventions might have taught Mr. Goodyear to expect. We need not

revive those disputes which embittered his life and wasted his substance and his time. The Honorable Joseph Holt, the Commissioner who granted an extension of the vulcanizing patent in 1858, has sufficiently characterized them in one of the most eloquent papers ever issued from the Patent Office :—

“No inventor probably has ever been so harassed, so trampled upon, so plundered by that sordid and licentious class of infringers known in the parlance of the world, with no exaggeration of phrase, as ‘pirates.’ The spoiliations of their incessant guerilla warfare upon his defenceless rights have unquestionably amounted to millions. In the very front rank of this predatory band stands one who sustains in this case the double and most convenient character of contestant and witness; and it is but a subdued expression of my estimate of the deposition he has lodged, to say that this Parthian shaft—the last that he could hurl at an invention which he has so long and so remorselessly pursued—is a fitting finale to that career which the public justice of the country has so signally rebuked.”

Mr. Holt paid a noble tribute to the class of men of whose rights he was the official guardian :—

“All that is glorious in our past or hopeful in our future is indissolubly linked with that cause of human progress of which inventors are the *preux chevaliers*. It is no poetic translation of the abiding sentiment of the country to say, that they are the true jewels of the nation to which they belong, and that a solicitude for the protection of their rights and interests should find a place in every throb of the national heart. Sadly helpless as a class, and offering, in the glittering creations of their own genius, the strongest temptations to unscrupulous cupidity, they, of all men, have most need of the shelter of the public law, while, in view of their philanthropic labors, they are of all men most entitled to claim it. The schemes of the politician and of the statesman may subserve the purposes of the hour, and the teachings of the moralist may remain with the generation to which they are addressed, but all this must pass away; while the fruits of the inventor’s genius will endure as imperishable memorials, and, surviving the wreck of creeds and systems, alike of politics, religion, and philosophy, will diffuse their blessings to all lands and throughout all ages.”

When Mr. Goodyear had seen the manufacture of shoes and fabrics well established in the United States, and when his rights appeared to have been placed beyond controversy by the

Trenton decision of 1852, being still oppressed with debt, he went to Europe to introduce his material to the notice of capitalists there. The great manufactories of vulcanized India-rubber in England, Scotland, France, and Germany are the result of his labors; but the peculiarities of the patent laws of those countries, or else his own want of skill in contending for his rights, prevented him from reaping the reward of his labors. He spent six laborious years abroad. At the Great Exhibitions of London and Paris, he made brilliant displays of his wares, which did honor to his country and himself, and gave an impetus to the prosperity of the men who have grown rich upon his discoveries. At the London Exhibition, he had a suit of three apartments, carpeted, furnished, and decorated only with India-rubber. At Paris, he made a lavish display of India-rubber jewelry, dressing-cases, work-boxes, picture-frames, which attracted great attention. His reward was, a four days' sojourn in the debtors' prison, and the cross of the Legion of Honor. The delinquency of his American licensees procured him the former, and the favor of the Emperor the latter.

We have seen that his introduction to India-rubber was through the medium of a life-preserver. His last labors, also, were consecrated to life-saving apparatus, of which he invented or suggested a great variety. His excellent wife was reading to him one evening, in London, an article from a review, in which it was stated that twenty persons perished by drowning every hour. The company, startled at a statement so unexpected, conversed upon it for some time, while Mr. Goodyear himself remained silent and thoughtful. For several nights he was restless, as was usually the case with him when he was meditating a new application of his material. As these periods of incubation were usually followed by a prostrating sickness, his wife urged him to forbear, and endeavor to compose his mind to sleep. "Sleep!" said he, "how can I sleep while twenty human beings are drowning every hour, and I am the man who can save them?" It was long his endeavor to invent some article which every man, woman, and child would necessarily wear, and which would make it impossible for them to sink. He experimented with hats, cravats, jackets, and petticoats; and, though he left his principal object incomplete, he

contrived many of those means of saving life which now puzzle the occupants of state-rooms. He had the idea that every article on board a vessel seizable in the moment of danger, every chair, table, sofa, and stool, should be a life-preserver.

He returned to his native land a melancholy spectacle to his friends, — yellow, emaciated, and feeble, — but still devoted to his work. He lingered and labored until July, 1860, when he died in New York, in the sixtieth year of his age. Almost to the last day of his life he was busy with new applications of his discovery. After twenty-seven years of labor and investigation, after having founded a new branch of industry, which gave employment to sixty thousand persons, he died insolvent, leaving to a wife and six children only an inheritance of debt. Those who censure him for this should consider that his discovery was not profitable to himself for more than ten years, that he was deeply in debt when he began his experiments, that his investigations could be carried on only by increasing his indebtedness, that all his bargains were those of a man in need, that the guilelessness of his nature made him the easy prey of greedy, dishonorable men, and that his neglect of his private interests was due, in part, to his zeal for the public good.

Dr. Hutton of New Haven, his pastor and friend, in the Sermon dedicated to his memory, did not exaggerate when he spoke of him as

“one who recognized his peculiar endowment of inventive genius as a divine gift, involving a special and defined responsibility, and considered himself called of God, as was Bezaleel, to that particular course of invention to which he devoted the chief part of his life. This he often expressed, though with his characteristic modesty, to his friends, especially his religious friends. . . . His inventive work was his religion, and was pervaded and animated by religious faith and devotion. He felt like an apostle, commissioned for that work; and he said to his niece and her husband, who went, with his approbation and sympathy, as missionaries of the Gospel to Asia, that he was God’s missionary as truly as they were.”

Nothing more true. The demand for the raw gum, almost created by him, is introducing abundance and developing industry in the regions which produce it. As the culture of cotton seems the predestined means of improving Africa, so the

gathering of caoutchouc may procure for the inhabitants of the equatorial regions of both continents such of the blessings of civilization as they are capable of appropriating.

An attempt was made last winter to procure an act of Congress extending the vulcanizing patent for a further period of seven years, for the benefit of the creditors and the family of the inventor. The petition seemed reasonable. The very low tariff paid by the manufacturers could have no perceptible effect upon the price of articles, and the extension would provide a competence for a worthy family who had claims upon the gratitude of the nation, if not upon its justice. The manufacturers generally favored the extension, since the patent protected them, in the deranged condition of our currency, from the competition of the foreign manufacturer, who pays low wages and enjoys a sound currency. The extension of the patent would have harmed no one, and would have been an advantage to the general interests of the trade. The son of the inventor, too, in whose name the petition was offered, had spent his whole life in assisting his father, and had a fair claim upon the consideration of Congress. But the same unscrupulous and remorseless men who had plundered poor Goodyear living, hastened to Washington to oppose the petition of his family. A cry of "monopoly" was raised in the newspapers to which they had access. The presence in Washington of Mrs. Goodyear, one of the most retiring of women, and of her son, a singularly modest young man, who were aided by one friend and one professional agent, was denounced as "a powerful lobby, male and female," who, having despoiled the public of "twenty millions," were boring Congress for a grant of twenty millions more,—all to be wrung from an India-rubber-consuming public. The short session of Congress is unfavorable to private bills, even when they are unopposed. These arts sufficed to prevent the introduction of the bill desired, and the patent has since expired.

The immense increase in the demand for the gum has frequently suggested the inquiry whether there is any danger of the supply becoming unequal to it. There are now in Europe and America more than a hundred and fifty manufactories of India-rubber articles, employing from five to five hundred op-

eratives each, and consuming more than ten millions of pounds of gum per annum. The business, too, is considered to be still in its infancy. Certainly, it is increasing. Nevertheless, there is no possibility of the demand exceeding the supply. The belt of land round the globe, five hundred miles north and five hundred miles south of the equator, abounds in the trees producing the gum, and they can be tapped, it is said, for twenty successive seasons. Forty-three thousand of these trees were counted in a tract of country thirty miles long and eight wide. Each tree yields an average of three table-spoonfuls of sap daily, but the trees are so close together that one man can gather the sap of eighty in a day. Starting at daylight, with his tomahawk and a ball of clay, he goes from tree to tree, making five or six incisions in each, and placing under each incision a cup made of the clay which he carries. In three or four hours he has completed his circuit and comes home to breakfast. In the afternoon he slings a large gourd upon his shoulder, and repeats his round to collect the sap. The cups are covered up at the roots of the tree, to be used again on the following day. In other regions the sap is allowed to exude from the tree, and is gathered from about the roots. But, however it is collected, the supply is superabundant; and the countries which produce it are those in which the laborer needs only a little tapioca, a little coffee, a hut, and an apron. In South America, from which our supply chiefly comes, the natives subsist at an expense of three cents a day. The present high price of the gum in the United States is principally due to the fact that greenbacks are not current in the tropics; but in part, to the rapidity with which the demand has increased. Several important applications of the vulcanized gum have been deferred to the time when the raw material shall have fallen to what Adam Smith would style its "natural price."

Charles Goodyear's work, therefore, is a permanent addition to the resources of man. The latest posterity will be indebted to him.